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ABSTRACT

A composite materials education program was established to train Boeing Helicopter Company employees in the special processing of new filament-reinforced polymer composite materials. During the personnel development phase of the joint Boeing-Penn State University project, an engineering instructor from Penn State completed a 5-month, full-time resident training program in the Boeing plant in June 1988. The instructor received in-depth training in the basic skills of composite layup, cure, fabrication, and assembly. A categorized reference library was initiated based on information gathered during the residency. Future plans were for research, design, and field testing of courses for a composite materials technology program, both in a credit and noncredit format, and use of a variety of funding models to support the program's continuance, including personal expense, tuition loans and grants, tuition reimbursement by industry, and federal and manpower employment training programs. (Attachments and appendixes, amounting to over three-fourths of the report, include resumes, letters of support, background and general information on Boeing, information on composite materials, data on projected manpower needs, a chronological list of program highlights, and program schedule bar chart.) (YLB)

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FINAL REPORT

INDUSTRY TO EDUCATION TECHNOLOGY TRANSFER PROGRAM

COMPOSITE MATERIALS - PERSONNEL DEVELOPMENT

~~(85-8061)~~
(86-8037)

Author: Dr. Edward S. J. Tomezsko

PENN STATE UNIVERSITY
DELAWARE COUNTY CAMPUS
MEDIA, PA 19063

July 15, 1988

PENNSYLVANIA DEPARTMENT OF EDUCATION
BUREAU OF VOCATIONAL AND ADULT EDUCATION
CURRICULUM AND PERSONNEL DEVELOPMENT SECTION

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II. FINAL REPORT SUMMARY

A. Abstract

1. Agency, address, etc.

Agency and address: Penn State University
Delaware County Campus
25 Yearsley Mill Road
Media, PA 19063

Project title: Industry to Education Technology Transfer Program
Composite Materials - Personnel Development

Contract number: 86-8037

Funding period: July 1, 1987 - June 30, 1988

Approved funds: $70,199

2. Purpose

Boeing Helicopter has developed a new tilt-rotor aircraft called the V-22 Osprey, whose structure is almost totally of advanced composite materials. This unique vehicle can take off and land vertically like a helicopter but it possesses the "up-and-away" performance of a turbo-prop fixed wing aircraft. Accordingly it is highly desired by the military who plan to purchase 900 to 1400 V-22's. This 40 billion dollar DOD contract will require Boeing to recruit 3000-4000 new employees over the next five years. These employees need to be made knowledgeable and skilled in the special processing of these new filament reinforced polymer composite materials. Boeing and Penn State have teamed to provide the required training to Pennsylvania residents so that Boeing will not be forced to subcontract the work out-of-state.

The purpose of this project is to establish the necessary composite materials education program. Boeing Helicopter Company is recognized world-wide as a leader in the application of composite materials to aircraft structures. They have agreed to share with the University their extensive knowledge and experience acquired through years of R&D in the manufacturing of composites. A senior faculty member from the Penn State Delaware County Campus completed a five-month, full time, resident training program in the Boeing plant in June, 1988. Next year he will develop curricula for six noncredit basic skills courses in composites, complete establishment of a new composites laboratory and training facility, and conduct field testing of the courses for invited vocational educational instructors and University faculty (to be conducted in mid 1989).

The objectives of the personnel development project were essentially accomplished with the successful completion of the Boeing residency program by a senior Penn State faculty member.

3. Objectives

   a. An engineering instructor and an assistant will "reside" at the Boeing Helicopter Company to carry out composite technology work assignments in various engineering, quality control, and manufacturing sections of the company.

   b. A data base will be developed from the technology exposure of the instructor at Boeing. It will consist of information techniques and hands-on engineering experience encountered by the instructors. The data base will consist of written and typed material. Key situations will be identified for videotaping.

4. Achievements

a. A senior engineering faculty member completed a five month full-time residency training program at Boeing. In view of his relevant past experience in the design and theoretical analysis of composite structures this was more than sufficient time for him to absorb the necessary manufacturing information from Boeing. Recruitment efforts to hire an assistant instructor continue.

b. An extensive data base of information has been assembled covering the experiences at Boeing. These include many Boeing instructional manuals; vendor equipment descriptions, descriptions of laboratory experiments and procedures, slides, photographs, etc. Video taping of identified operations will be conducted next year.

B. Financial Summary

	Budget	Actual	Balance
1. Instructional Salaries/Benefits	65,259	24,900	40,359
2. Noninstructional Salaries/Benefits	4,760	7,745	(2,985)
3. Other	180	285	(105)
Total	70,199	32,930	37,269

III. APPROACH

A. Background - Problem and Significance

Boeing Helicopter has developed a new tilt-rotor aircraft called the V-22 Osprey, whose structure is almost totally of advanced composite materials. This unique vehicle can take off and land vertically like a helicopter but it possesses the "up-and-away" performance of a turbo-prop fixed wing aircraft. Accordingly it is highly desired by the military who plan to purchase 900 to 1400 V-22's. This 40 billion dollar DOD contract will require Boeing to recruit 3000-4000 new employees over the next five years. These employees need to be made knowledgeable and skilled in the special processing of these new filament reinforced polymer composite materials. Boeing and Penn State have teamed to provide the required training to Pennsylvania residents so that Boeing will not be forced to subcontract the work out-of-state.

B. Purpose of Project

The purpose of this project is to establish the necessary composite materials education program. Boeing Helicopter Company is recognized world-wide as a leader in the application of composite materials to aircraft structures. They have agreed to share with the University their extensive knowledge and experience acquired through years of R&D in the manufacturing of composites. A senior faculty member from the Penn State Delaware County Campus, completed a five-month, full time residency training program in the Boeing plant in June, 1988. Next year he will develop detailed curricula for six noncredit basic skills courses in composites, complete establishment of a new composites laboratory and training facility, and conduct field testing of the courses for invited vocational educational instructors and University faculty (to be conducted in mid 1989).

Boeing and the University envision this partnership and project as the first "stepping stone" in a long term high technology sharing program which may continue to include in future projects CAD/CAM, robotics and high tech electronics. The long-range objective which can be accomplished by support of this Composite Materials project is to establish the S.E. Pennsylvania region as a nationally recognized composites center for research, design and manufacturing which will bring additional growth and employment to the Commonwealth through new business enterprises.

C. Pennsylvania State University Project Role

Overall responsibility for execution of this project, including receiving and expending funds as well as reporting project results rests with The Pennsylvania State University. The University is responsible to support this technology development by the creation of a phased program of course development. Phase 1 of the program will focus on developing a noncredit basic composite skills program. After some experience is gained with these noncredit courses, phase 2 will begin in which credit courses will be developed and submitted for University approval. Assuming University approval, and after gaining experience with both noncredit and credit courses and curricula, in subsequent years degree programs can be considered in phase 3 and submitted to the University for approval.

D. Boeing Helicopter Company Project Role

Boeing Helicopter Company has been a full partner in the planning of this effort. They played a primary role in initiating the program since indeed they created the opportunity which generated the need for a new educational program. They have hosted a senior faculty member at their plant for skills training and transfer of technology to the University. They have participated in all major planning meetings, have helped with preparation of proposals, have suggested equipment purchases, and have provided senior staff for advisory panels and course curricula planning and review.

The Boeing Helicopter Company will provide the technological expertise for the training and education effort. Because of their status as the "leading edge of knowledge" in composites and graphite composites, they will provide an indispensable role in the guidance and monitoring of this new technology education effort. They will provide historical background of the technology development, current industrial utilization procedures and close interface during the design and delivery of programming to update training levels so they stay consistent with current industry demands. Our project faculty and staff will be periodically returning to Boeing's manufacturing facility for updated in-house training programs to keep them current with the Boeing engineering staff.

Boeing Helicopter will additionally be opening their 4,000+ video tape library to the University for use in this long range educational project. For those subject areas involved in composites fabrication which are not necessary or economically feasible for the University to directly include in the training, Boeing staff will work with our instructors and video tape operations at Boeing to be used as supplemental instruction. (Areas such as water-jet and Gerber cutters, nondestructive testing using x-ray and radiographic processes, and others would be taped.) This service will provide us with a valuable instructional tool and library to be shared throughout the Commonwealth Educational System of Penn State University.

Finally, Boeing will be lending, where feasible and applicable, both its buying power and its staff expertise in the acquisition of the costly materials, and in the instruction of students in the basic composite skills program. Backup freezer capacity will be available as well as the generous donation of rejected fabrications in composites for our students to practice their drilling, reaming, cutting and fastening techniques. (This activity in the second and third year alone could total thousands of dollars in materials.)

Students for the training program will also be initially supplied from Boeing Helicopter Company. Because of the high cost of the materials consumed by a student in training and the small class size we must keep to provide proper training (16 students per class), we must maximize our training investment return. Boeing Helicopter will pre-screen the students to meet their employment and security requirements before we train them, thereby literally guaranteeing employment upon the successful completion of the training program. A small ratio of training slots will be set aside to train local area subcontractors as well as vocational institution instructors.

IV. PROJECT SUMMARY

A. Overall Goals and Future Direction

The "Industry to Education Technology Transfer Program - Composite Materials" general goals are:

1. To maintain and create jobs in new and existing firms;
2. To improve productivity, particularly in Pennsylvania's existing firms;
3. To diversify Pennsylvania's economy, with special emphasis on increasing Pennsylvania's share of those advanced technology firms and/or product markets that are among the national growth leaders.

This project also has the objective of establishing a long-range business-educational consortium, improving educational-training programs for workforce needs to adjust to changing technology--and finally our project encourages the creation and expansion of new technology enterprises through the Western Pennsylvania satellite operation.

This project focuses on developing new curricula in high technology using state-of-the-art equipment to provide a technology-literate workforce to the private sector for jobs that will be available. This is a unique situation with a clear partnership between a national industrial leader in high technology and a nationally recognized research and service educational institution, and it offers an unparalleled opportunity for economic growth for the geographic area. High technology curriculum design and delivery is an extremely expensive process. The equipment is limited in availability and is very expensive. Because high technology is often evolving, a great amount of time can be spent in exploring different directions in curriculum design. Finally the risk factor in developing a training capacity without a clear

future need (by current industry level of activity within the geographic service area) could result in an under-utilization of expanded training capacity. This project offers clear solutions to these traditional problem areas in providing new training in high technology areas. With Boeing having done the preliminary research in fabrication and assembly of composite materials and having determined the best approach, we can use that historical information to focus onto the best design of curriculum from the beginning. Since we are new to composite fabrication and assembly, our choice of equipment, for current and future needs might otherwise be somewhat risky. Our corporate liaison will assist us to focus on equipment and methodology that is state-of-the-art industry recognized and used. This will assure us that we train personnel to meet the real needs of industry, not just a perceived view of those needs. Finally, our Corporate partnership offers us a clear placement and growth potential for the students we train, with Boeing already needing a massive number of new employees in 1990.

B. Program Accomplishments

This project is part of a three-year effort to develop and deliver a composite materials technology educational experience.

In September, 1987, Dr. Tomezsko, the project director, attended a seminar in Seattle, Washington on Education/Industry Composite Materials Technology Transfer. The seminar was hosted by The Boeing Company and financially supported by the Delaware County Partnership for Economic Development. Among others in attendance, which reflects the importance of this project to the County of Delaware, were the Chairman of County Council, the President of the Partnership for Economic Development, the Assistant Secretary of Education of Pennsylvania, and the President of the Community College.

Design of a 6000 square foot classroom/laboratory building on campus has been completed. Final approval for a construction start this fall is expected shortly.

Specifications for all equipment have been completed, formal quotations received, and purchase orders sent forward for processing.

Dr. McQuillen completed his residency at Boeing Helicopter Company in June. He has received in-depth instruction in the basic skills of composite layup, cure, fabrication, and assembly.

The beginning of a categorized reference library has been initiated based upon information gathered during the Boeing residency.

Dr. McQuillen attended the Structures, Dynamics, and Materials Conference in Williamsburg, Virginia. The latest developments in composite structures and composite manufacturing processes were presented.

Planning has been developed for a program envisioned to consist of six noncredit basic skills courses on composite materials. Proposals have been prepared and submitted for support of curriculum development and required equipment.

During the reporting period a decision by Boeing Corporate Headquarters approved a request by Boeing Helicopter Company to provide $75,000 cash to Penn State Delaware County Campus over the next three years to support this program.

The search for a second faculty member continues with the objective of hiring a person with a masters degree in Mechanical Engineering and some professional experience in using composite materials as structural members.

C. Personnel Development Accomplishments

In January, 1988, Dr. Edward J. McQuillen was hired as an associate professor of general engineering. He recently retired from the Naval Air Development Center at Warminster, Pennsylvania. While there, one of his jobs was Head of the Aero Structures Division. In that position he was instrumental in the application of advanced composite structures to a number of Naval aircraft including the F-18 and the AV-8B. In addition, he personally led a design team that analytically synthesized the design of a graphite epoxy wing for a supersonic unmanned aircraft. That wing which was the first advanced composite wing ever to fly provided a weight saving over 50%.

Most of Dr. McQuillen's past experience with composite structures was in design, analysis, and theoretical estimates of strength, stiffness, and durability. Since joining the University in January he has been resident in house at the Boeing Helicopter Company observing and learning how they process and manufacture composite structures. Although that residency is now completed, it is expected that he will return to Boeing in the future, from time to time, for a couple of days (or weeks) to become cognizant of new processes as they emerge.

During the time at Boeing, Dr. McQuillen was given the opportunity to learn and develop the mechanical skills involved in processing, manufacturing and assembling composite structures.

In addition to participation in a series of formal Boeing training courses on composite materials fabrication and manufacture, many detailed technical discussions and meetings were conducted with Boeing specialists for the purpose of transferring Boeing's state-of-the-art technology to the University. These personal contacts and acquaintances will be useful as the program continues.

Completion of the residency program at Boeing has essentially accomplished the objectives of this personnel development program. The combination of previous theoretical, analytical, and design skills with the "hands-on" basic skills acquired at Boeing provides a unique qualification to provide positive input to this program in the planning, development of curricula and finally in the delivery of courses to accomplish the goals of this program.

D. Project Continuance

It is anticipated that a variety of funding models will be used to support the continuance of a Composite Materials Technology program once the initial research, design and field testing of the courses, both in a credit and noncredit format, are completed. Credit courses will be paid for by the traditional means of personal expense, tuition loans and grants, and a significant level of tuition reimbursement by corporations and industry. Boeing is already anticipating that staff of both engineering and support functions and expecially new degree hires will be encouraged to participate in additional credit, certificate, or degree programs focusing on Composite Materials Technology.

The massive employment training in the Basic Composite Skills program will be funded through various Federal and State Manpower employment training programs such as Customized Job Training. Discussions with the organizations governing these programs have already occurred.

E. Economic Impact

By the third year of this project we will be conducting a full scale "Basic Composite Skills" training program to meet the 3,000-4,000 new employee projection for basic contract commitment by Boeing Helicopter Company. The minimum training and hiring projections for this composite materials program are 1,000 new hires by 1991 and 3,500 new hires by 1995. These projections

for high paying manufacturing jobs are reported by Boeing to be conservative given additional interest and likely production of the V-22 for commercial use after the large military production contracts are completed. As a minimum, the Penn State Shenango Valley Campus will be offering their satellite composite materials program. Projections are that their program will train approximately 500 people for subcontractors and firms in the western part of the state by 1992.

We conservatively project we will be training 500 to 1,000 students per year for virtually guaranteed new positions at Boeing. The Commonwealth will realize a revenue gain of 2-1/2 million dollars the first year of employment through income and sales taxes alone.

If we do not provide Pennsylvania residents the opportunity to capture these new jobs, Boeing will hire whom they can from Delaware and New Jersey. They could also be forced to export the work to other states by subcontract if they cannot hire the properly trained personnel in the required numbers.

YEAR	NUMBER OF NEW JOBS
1991	750
1992	750
1993	750
1994	750
	3000 Total

Participation will be open to all people, including disadvantaged, handicapped and minority. Strict adherance to open employment policies will be maintained as Boeing must verify adherance because of requirements of their federal contracts. Boeing will advertise and conduct pre-employment interviews prior to enrollment in the training programs to maximize utilization of the program.

Once developed and implemented, the Composite Materials Technology efforts on a noncredit and credit basis will be made known to potential applicants through the efforts of the school's counseling, advising, and admissions staff, Pennsylvania job service, as well as through the myriad publications announcing Penn State Delaware County Campus program offerings and promoting enrollment and matriculation at the Penn State Delaware County Campus. Similar enrollment and announcement activities will be followed by the Penn State Shenango Valley Campus in the offering of their satellite composite materials program.

A. RESUMES

Edward S. J. Tomezsko
4 Prince Eugene Lane
Media, Pennsylvania 19063
April, 1988

Business Telephone 215-565-3300
Home Telephone 215-565-2989

STRENGTHS: Industrial and university experience; continuing professional and personal development; analytic and quantitative; dedication to quality; creative; decisive and fair minded; capable at planning and implementing a plan; works well with people.

CURRENT EMPLOYMENT: Executive Officer
The Pennsylvania State University
Delaware County Campus

CAMPUS ADDRESS: 111 Main Building
Media, Pa. 19063

1. SUMMARY OF PREVIOUS PROFESSIONAL EXPERIENCE:

1986	Executive Officer Delaware County Campus
1985 to 1986	Assistant Vice President and Director, acting Division of Technology The Pennsylvania State University Commonwealth Educational System
1984 to 1985	Associate Dean for Academic Affairs, acting The Pennsylvania State University Commonwealth Educational System Associate Professor of Chemistry
1981 to 1984	Director of Academic Affairs The Pennsylvania State University Delaware County Campus Associate Professor of Chemistry
1977 to 1981	Associate Professor of Chemistry The Pennsylvania State University Delaware County Campus
1971 to 1977	Assistant Professor of Chemistry The Pennsylvania State University Delaware County Campus
1967 to 1971	Senior Research Chemist and Group Leader ARCO Chemical Company

1964 to 1967	Senior Research Chemist ARCO Chemical Company
1962 to 1964	Resident Research Associate National Bureau of Standards

2. EDUCATIONAL BACKGROUND:

1962	Doctor of Philosophy, Physical Chemistry The Pennsylvania State University Department of Chemistry Thesis: The Nature of the Platinum Surface Preceptor: Professor John G. Aston
1961	Master of Science, Fuel Technology The Pennsylvania State University Department of Fuel Technology Thesis: Preparation and Properties of Activated Carbons by Nitric Acid Oxidation of Bituminous Coal Preceptor: Assistant Professor Theodore S. Polansky
1957	Bachelor of Science, Chemistry Villanova University Villanova, Pa.

3. HONORS AND AWARDS:

1979	Visiting Lecturer, Johnson Foundation University of Pennsylvania School of Medicine
1979	Listed in Who's Who in the East
1976	Pius X Medal, Awarded by the Archdiocese of Philadelphia, for contributions to the development of Adult Education Programming in the Archdiocese, Presented by John Cardinal Krol
1975	Faculty Exchange Program to University Park Campus, The Pennsylvania State University
1975	Listed in American Men and Women of Science
1974	Outstanding Teaching Award The Pennsylvania State University Delaware County Campus
1973	Honorary Member, The Keystone Society The Pennsylvania State University
1962	National Research Council, Resident Research Associate Fellowship National Bureau of Standards
1961	Membership in the Society of Sigma Xi
1960	Membership in Phi Lambda Upsilon

4. ADMINISTRATIVE EXPERIENCE:

July 1986 to present — Executive Officer
The Pennsylvania State University
Delaware County Campus

RESPONSIBILITIES: Reporting to the Vice President and Dean of the Commonwealth Educational System, I was appointed by the University President as Campus Executive Officer. I am responsible for campus planning as well as routine management of the campus. Six senior division heads report to me. The campus has a faculty of approximately 60 full time faculty, 40 adjunct faculty, 40 staff and technical support, and 1250 full time, degree students and 550 part-time students. The annual budget is $4.8 million.

- plan and implement a capital campaign for the campus which is integrated with the Campaign for Penn State, a university-wide, $200 million fund raising effort;
- continue to develop and implement, working with selected faculty and staff, a five year strategic plan for the campus;
- develop a plan to enhance and enlarge the physical plant of the campus;
- build a strategy for effective inter-campus cooperation between the three Penn State campuses in the Delaware Valley.

ACCOMPLISHMENTS: For the campus, we have:

- completing construction on a $3.9-million Commons - Athletic Center;
- Working with Boeing Helicopter Company and Delaware County Community College to develop an in-plant educational program, in which Penn State will provide the mechanical engineering technology associate degree program and mechanical engineering baccalaureate degree program, both with a composite materials emphasis;
- reorganize the campus admissions office and increase it staff as recommended by the campus strategic plan in order to improve the cost effectiveness of the campus; implicit in the reorganization is application of campus resources to recruit more effectively both traditional and non-traditional students and the creation of a marketing consulting group made up of industrial professionals who will assist the campus administration in the identification of new educational programs needed in the region and of programs which have out-lived their usefulness in the region.

R E S U M E

Dr. Edward J. McQuillen
395 Keats Road
Huntingdon Valley, PA 19006
(215) 947-2695

PERSONAL DATA

Age:	58	Date of Birth:	20 November 1929
Weight:	185 pounds	Height:	5'9"
Status:	Married	Children:	7 daughters, 1 son

EDUCATION

School	Dates Attended	Degree
LaSalle High School	Sept 1943 to June 1947	
University of Penn	Sept 1947 to June 1951	BS in ME June 1951
Drexel Inst. of Tech.	Sept 1952 to June 1956	MS in ME June 1956
University of Penn	Sept 1957 to May 1968	PH.D in Engr. Mech. May 1968

TITLE OF DOCTORAL DISSERTATION:

"Dynamic Fully-Coupled Thermoelastic Response of Cylindrical Shells"

THESIS ADVISOR:

Professor M. A. Brull, Chairman, Division of Engineering Mechanics

EXPERIENCE

June 1951 to April 1953	Brown Instruments Division of M-H Regl. Co. Wayne & Robbins Avenues Philadelphia, PA	Junior Design Engineer
April 1953 to July 1954	Flexrock Company 3609 Filbert Street Philadelphia, PA	Mechanical Engineer
July 1954 to Feb. 1957	Radio Corp. of America Def. Electronics Prod. Div. Airborne Fire Control Camden, NJ	Mechanical Engineer
Feb. 1957 to Aug. 1957	Curtis Wright Corp. (Turbomotor Div. Disestablished) Turbo Motor Division Trenton, NJ	Analytical Engineer

Aug. 1957 to Sept. 1987	Naval Air Development Center Aero Mechanics Department Aeronautical Engineering Div. Warminster, PA 18974	Aero-Research Engineer
1957-1965		Aero Research Engineer
1965-1970		Head, Analysis & Flight Test
1970-1972		Head, Applied Mechanics Research Group
1972-1974		Head, Structures Research Branch
1974-1978		Superintendent, Aero Structures Division
1978-1980		Superintendent, Aircraft Systems & Integration Div.
1980-1987		Superintendent, Aero Analysis Division
1987		Director, Air Vehicle Technology & Program Office

Appointed to Senior Executive Service on June 6, 1985
Retired September 3, 1987

DR. EDWARD J. McQUILLEN

PUBLICATIONS

"MO/2005 Long Term Scientific Study on Air Vehicles and Their Use in Maritime Operations in the Year 2005", NATO (SECRET) Report AC 243-D/0138, E. J. McQuillen, Study Director, of May 1986.

"High Altitude, Long Endurance RPV Design Technology Study" by C. Henderson, E. J. McQuillen, and L. Lehman. Paper presented at AGARD Conference, "Guidance, Control, and Positioning of Future Precision Guided Stand-Off Weapon Systems", Conference Proceedings No. 388, of May 1985.

"High Altitude, Long Endurance, RPV Design Technology Study" by C. Henderson and E. J. McQuillen, et. al., Report No. NADC 85060-60 of Mar 85.

"Annual Report of the Navy Aeroballistics Committee to the Naval Air Systems Command and the Naval Sea Systems Command for 1984" by E. J. McQuillen, NADC Report No. NADC-84067-60 of Apr 84.

"Low Velocity Impact of a Viscoelastic Beam", R. E. Llorens and E. J. McQuillen, published in Journal of Engineering for Industry, Vol. 104, May 1983.

"Off-Center, Low Velocity, Transverse Normal Impact of a Simply Supported Plate", R. E. Llorens and E. J. McQuillen, Report No. NADC-79215-60, 11 September 1979.

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"Low Velocity Transverse Normal Impact of Graphite Epoxy Composite Laminates", published in the J. Composite Materials, Vol. 10, (Jan. 1976).

NADC Report No. 75119-30, "Low Velocity Transverse Normal Impact of Graphite Epoxy Composite Laminates", E. J. McQuillen, R. E. Llorens, L. W. Gause, dated 1 December 1975.

"Material Characterization on the Fracture of Filament-Reinforced Composites", George C. Sih, E. P. Chen, S. L. Huang, and E. J. McQuillen, published in the Journal of Composite Materials, Vol. 9, April 1975.

"Arbitrary Axially Symmetric Distributions of Axial and Radial Loads in Infinite, Multibody Elastic Solids", R. E. Llorens and E. J. McQuillen, published in the Journal Applied Mechanics, December 1974.

NADC Report No. 74196-30,"Viscoelastic Creep and Relaxation in Laminated Composites", Edward B. Schwartz and Edward J. McQuillen, dated 4 November 1974.

Journal of Aircraft, "Graphite-Epoxy Wing for BQM-34E Supersonic Aerial Target", by E. J. McQuillen and S. L. Huang, May 1971.

AIAA/ASME 11th Structures, Structural Dynamics, and Materials Conference, Denver, Colorado. Paper presented 24 April 1970 by E. J. McQuillen, "Graphite-Epoxy Wing for BQM-34E Supersonic Aerial Target", by E. J. McQuillen and S. L. Huang.

12th International Congress of Applied Mechanics, Stanford University, California. Paper presented 28 March 1969 by E. J. McQuillen, "Dynamic Fully-Coupled Thermo-eastic Response of Thin Cylinders to Thermal Inputs", by E. J. McQuillen and M. A. Brull.

DR. EDWARD J. McQUILLEN

PUBLICATIONS

"Dynamic Fully-Coupled Thermoelastic Response of Thin Cylinders to Thermal Inputs", University of Pennsylvania Ph.D. dissertation, May 1968.

"Dynamic Fully-Coupled Thermoelastic Response of Cylindrical Shells", NADC Report No. NADC-AM-6815, May 1968.

"Flutter Analysis of the Wing of the XBQM-34E Supersonic Target", NADC Report No. NADC-AM-6650, 14 Nov 1966.

"Description and Airframe-Autopilot Dynamic Analysis of QF-8A Pilotless Target Aircraft", NADC Report No. NADC-ED-6458, 2 Mar 1965.

"Longitudinal Arrestment of High Velocity Mass by Linear Elastic Tow-line", Engineering Memo TS-207, 17 Sep 1962.

"Target Requirements Study; Updated Navy RD&E Missile Testing Needs - 1961 to 1968 (U)", NADC Confidential Report No. NADC-ED-6028, 20 Feb 1961.

"Target Requirements Study; Applicability of a Statistical Technique to the Design of Missile Flight Test Programs", NADC Report No. NADC-ED-5939, Apr 1960.

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"Target Requirements Study: Phase 1 - Navy RD&E Needs to 1965; Analysis of Basic Performance Data (U)", NADC Secret Report No. NADC-ED-5912, Feb 1959.

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"Target Requirements Study; Phase 1 - Supersonic Target Endurance for Navy RD&E Testing (U)", NADC Confidential Report No. NADC-ED-5938, Aug 1959.

"Target Requirements Study; Phase II - Navy Target Needs of Fleet Operating Units Through 1965, Firing Objectives (U)", NADC Secret Report No. NADC-ED-5934, 1959.

PATENTS

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"Mechanical Rotary Accelerometer," U.S. Patent No. 3,183,724 of May 1965.

"Small One-Way Reel with Viscous Drag," U.S. Patent No. 3,211,396 of 12 October 1965.

"Cross-Reinforcement in a Graphite-Epoxy Laminate," U.S. Patent No. 4,350,728 of 21 September 1982.

RECOGNITION AND AWARDS

- Many outstanding performance ratings and letters of appreciation.
- Sustained Superior Performance Award ($250.00) - 18 July 1962.
- Superior Achievement Award ($100.00) for Definition of Target Requirements - 24 July 1962.
- First recipient of NADC Advanced Graduate Study Award (one academic year of study with full pay, tuition, expenses) - 1964-1965.
- Awarded Ford Foundation Fellowship (one academic year 1964) - declined to accept NADC award.
- Commander, NADC letter dated 25 May 1973 (for publication of Technical Article) "Graphite/Epoxy Wing for BQM-34E Supersonic Aerial Target," published in Journal of Aircraft ($200.00) shared equally with Dr. S. L. Huang.
- Merit Pay Cash Award ($2,500.00), 25 November 1981.
- Incentive Award (Invention) ($100.00), 12 December 1982.
- Merit Increase ($1,380.00), 2 October 1983.
- Merit Cash Award)$1,465.00), 30 October 1983.
- Outstanding Performance Rating, August 1984, Cash Award.
- Director of NATO Long-Term Scientific Study on Air Vehicles and their use in Maritime Operations MO/2005.
- Chairman, Naval Aeroballistics Committee 1983 and 1984.
- Competitively selected for the Navy SES Pre-Certification Program with managerial qualifications approved by the OPM-QRB.
- Associate Fellow and past council member, AIAA.
- Past member of AIAA Structural Dynamics Technical Committee.
- Paper presenter and/or session chairman at many national technical meetings.
- Promoted to SES on 6 June 1985.
- Superior Performance Rating for period 7-1-85 to 6-30-86.
- Superior Performance Rating for period 7-1-86 to 6-30-87.
- Meritorious Civilian Service Award 1987

PROFESSIONAL AFFILIATIONS

AIAA, Associate Fellow and Past Council Member, Philadelphia Section
Chairman, Navy Aeroballistics Committee, 1983 and 1984
Director, NATO Long-Term Scientific Study on Air Vehicles and Their Use in Maritime Operations MO/2005

Has Taught Graduate Engineering Mechanics Courses, Penn State University, King of Prussia Graduate Center:

EMCH 522 Theory of Mechanical Vibrations
EMCH 500 Advanced Mechanics of Materials
EMCH 507 Theory of Elasticity & Applications

Chairman at Design Engineering Conference on 9 April 1973, "Fracture and Stress Analysis as a Design Tool"
CH-53E R&M Review with Assistant Secretary of the Navy Marcy, February 1976
Session Chairman "3rd Conference on Fibrous Composites in Flight Vehicle Design," Williamsburg, VA, November 1975
Session Chairman "Fourth Army Materials Technical Conference, "Advances in Joining Technology," Boston, MA, September 1975
Participated in A/F Workshop on Durability of Composites, at Battelle, Columbus, OH, September 1975
Discussion Leader at I.D.A. 2nd Metal Matrix Workshop, Washington, D.C., September 1975
XFV-12A Composite Wing Review at N.AM Columbus, July 1975
Presented paper and served as discussion leader at 1st I.D.A. Workshop on Metal Matrix Composites, Washington, D.C., July 1975
Structures Apportionment Briefing at NRL, May 1975
Session Chairman, AIAA 16th SDM Conference "IMPACT," Denver, CO, May 1975

B. LETTERS OF SUPPORT

CURT WELDON
7TH DISTRICT, PENNSYLVANIA

COMMITTEE ON ARMED SERVICES
SUBCOMMITTEES
DEFENSE POLICY PANEL
MILITARY INSTALLATIONS AND FACILITIES
MILITARY PERSONNEL AND COMPENSATION
SEAPOWER AND STRATEGIC AND CRITICAL MATERIALS

COMMITTEE ON MERCHANT MARINE AND FISHERIES
SUBCOMMITTEES
COAST GUARD AND NAVIGATION
FISHERIES AND WILDLIFE CONSERVATION AND THE ENVIRONMENT
PANAMA CANAL/OUTER CONTINENTAL SHELF

Congress of the United States
House of Representatives
Washington, DC 20515

1233 LONGWORTH HOUSE OFFICE BUILDING
WASHINGTON, DC 20515
(202) 225-2011

DISTRICT OFFICES:
1554 GARRETT ROAD
UPPER DARBY, PA 19082
(215) 259-0700

2501 SOUTH 71ST STREET
PHILADELPHIA, PA 19142
(215) 365-7755

June 6, 1988

Mr. Robert Harrison
Chief
Eastern Regional Field Office
Bureau of Vocational and Adult Ed.
2814 Walbert Avenue
Allentown, Pennsylvania 18104

Dear Mr. Harrison:

I am writing to support the grant proposal submitted by the Delaware County Campus of Penn. State University. The Continuing Education Department at the University has enriched the lives of thousands of residents of this area. The job training and skills offered by the school are vital to the economic development of the county.

The Continuing Education Department is seeking this grant from the Carl Perkins legislation. The funding will be used to expand vocational education through the Industry to Education Technology Transfer Program. Boeing Helicopters, a partner in the project, acknowledges the need for skilled workers in composite materials. The program at Penn State is an effective combination of education and job skills training. Graduates of this program will find plentiful job opportunities in the marketplace.

I fully support the proposal made by Penn State Delaware County. The cooperation of public education and private industry is helping to provide for the welfare of Delaware County residents. Every effort should be made to support such initiatives.

If there is any way in which I can be of assistance, please do not hesitate to call.

Sincerely,

CURT WELDON
Member of Congress

CW/wtw

RECEIVED JUN 6 1988

B. LETTERS OF SUPPORT

BOEING HELICOPTER COMPANY
A Division of The Boeing Company

Mail Stop P
P.O. Box 16858
Philadelphia, PA 19142

April 20, 1988

Dr. Edward S. J. Tomezsko
Campus Executive Officer
Penn State Delaware County Campus
25 Yearsley Mill Road
Media, PA 19063

Dear Ed,

Attached please find your requested listing of planned Boeing Helicopters' in-kind contributions for an one year period ending June 30, 1989. I understand that this information can provide a basis for acquiring additional funding in support of the Industry to Education Technology Transfer Program.

Ed, the following information is provided to support your proposals for Ben Franklin State and Federal Funding of the program.

- Total Boeing Cash Contributions - $25,000.00
- Total Boeing Helicopters In-Kind Contributions - $89,220.00
- Total Employees at Boeing Helicopters/BCS - 6,855
- Number of Employees that are Pennsylvania Residents - 5,525
- Federal Identification Number - 91-0425694

If I can be of any further assistance, please feel free to call.

Sincerely,

D. Marinelli
Dominic Marinelli

GC/mb

Attachment

POSSIBLE BOEING IN-KIND CONTRIBUTIONS

Consulting with Penn State on Curriculum Development 5 days/course x 6 courses = 30 person days	$ 4,800.00
Short Course Training Updates for Senior Faculty Member and Assistant	
3 - 2 Week Programs (240 Hours)	
Instructor	$ 4,440.00
Development Costs	$17,760.00
CR's Management	$ 2,400.00
Publication Costs	$ 100.00
Materials Costs	$ 1,000.00
Videotaping of Operations, Processes and Machine Use	
30 Person Days	$ 4,080.00
Effort Management	$ 480.00
Materials Costs	$ 200.00
Cured Materials Donated for Student Use: Composite Materials, Graphite Panels, Structural Channels, etc.	$20,000.00
Benefits on Personnel	$33,960.00
TOTAL:	$89,220.00

PENNSTATE
Shenango Valley Campus
Campus Executive Office
(412) 981-1640
147 Shenango Avenue
Sharon, PA 16146

April 7, 1988

Advanced Technology Center
of Central & N.E. Pennsylvania
Penn State University
416 Old Main
University Park, PA 16802

RE: Ben Franklin Proposal Industry
to Education Technology Transfer
Program

The Shenango Valley Campus is pleased to have the opportunity to participate with Delaware County in the development and submission of a proposal to the Ben Franklin Partnership for the purpose of preparing individuals to work in composite materials.

The Shenango Valley Campus has had extensive experience in offering a program in metallurgical technology. This program continues to evolve as it now offers experiences in powder metallurgy. The program leader, Dr. Murray Small, is currently guiding the University in the revising of the metallurgy program into a materials technology program. We believe that this program and our extensive relationships with companies in the metals industry is a natural compliment to the proposed efforts of Delaware County.

In addition to our experience with a metallurgical technology program, the Campus has four faculty members (resumes furnished upon request) who have devoted their research efforts to various facets of materials. We believe that Shenango Valley's extensive involvement in both materials training and research is compatible with the proposed program developed by Delaware County. Some specific areas of research capability include:

(1) specialized equipment such as Lindberg Model 51314 Furnace with 1700 C capabilities, Atmosphere Control System, Polentiostat-Gabanostat, ESR Recording Spectrometer, Keithley Type All Electrical Conductivity System, Gas Chromatography and Tukon Microhardness Tester;

(2) experience in the production of electronic ceramics, electrochemical characterization, and magnetic and electronic properties characterization;

RECEIVED APR 13 1988

An Equal Opportunity University

(3) on-going research involvement with Penn State's world famous Materials Research Laboratory; and

(4) experience with Ben Franklin Partnership projects with a pipe tube company, an electronics firm, and currently developing one with a new generation high energy permanent magnet reproducer.

The Shenango Valley Campus' location in Western Pennsylvania, with the economic dislocations that it has suffered since the 1970's, is an ideal location for an effort by the Commonwealth of Pennsylvania to reinvigorate the economy through support of Boeing's interest in preparing workers for jobs in composite materials technology. Moreover, we are near several firms that are involved in either the production of composite materials, or who are significant users of composite materials (e.g., General Motors Lordstown, Ohio plant).

We look forward to this opportunity and are prepared to support your efforts.

Sincerely,

Charles R. Bursey
Acting Campus Executive Officer

CRB/ld

cc: E. Tomeszko
D. English
D. McComb

BOEING HELICOPTER COMPANY
A Division of The Boeing Company

Mail Stop P
P.O. Box 16858
Philadelphia, PA 19142

March 2, 1988

Dr. Edward Tomezsko
Campus Executive Director
Pennsylvania State University
Delaware County Campus
25 Yearsly Mill Road
Media, Pa. 19063

Dear Ed,

I am pleased to recommend Pete Dixon and Dick Ostlund to serve on your Composite Materials Board. Pete is our Manager of Manufacturing Research and Development and Dick is our Deputy Director V-22 Engineering and ILS. Both men have extensive current composites background, and are also involved in determining future directions for composite design and manufacturing.

Brief resumes are attached. Please feel free to contact them at your convenience.

Sincerely,

Bob Curley

Robert E. Curley, Jr.
Director of Personnel

cc: B. F. Baldwin
P. G. Dixon
R. T. Ostlund

Peter G. Dixon
349 S. New Middletown Road
Media, Pa. 19063

Home Phone: 215-566-0859
Work Phone: 215-591-3643

Manager - Manufacturing Research
and Development

Richard T. Ostlund
7 Eagleview Drive
Newtown Square, Pa. 19073

Home Phone: 215-353-5147
Work Phone: 215-591-8626

Deputy Director - V-22 Engineering

Peter G. Dixon

Manager - MR & D Techniques/Processes
Boeing Helicopters

EDUCATION

MSME (HND) Lanchester College - England
BSME (ONC) Lanchester College - England

EXPERIENCE

1955 - 1965	Hawker Siddeley Dyn., Ltd - Aero Engineer
1965 - 1967	Lockheed Hydraulic Brake Co. - Engineer
1967 - Present	Boeing Helicopters

SUMMARY OF BOEING EXPERIENCE

	FUNCTION	PROGRESSED TO
1967 - 1973	Aeronautic Technology	Sr. Engineer I
1973 - 1974	Wind Tunnel	Supervising Engineer
1974 - 1976	Rotor Blade Design	Supervising Engineer
1977 - 1984	Mechanical Design (Rotor Blade/Main Rotor Design)	Project Manager
1984 - Present	Manufacturing R & D	Manager

LANGUAGE CAPABILITY

French - Read
German - Read

BOEING RECOGNITION

Corporate Recognition - Project Engineer Bearingless Main Rotor Program - Demonstrated use of composite material in design of rotor hub and control system.

Over 150 hours of Boeing Sponsored Management training

Richard T. Ostlund

Deputy Director Engineering and ILS-V22 Program
Boeing Helicopters

EDUCATION

BSME Seattle University - 1960
MBA Seattle University - 1980

MILITARY SERVICE

1957 - 1960 U.S. Army; progressed to 1ST Lieutenant
1961 - 1963 Captain - U.S. Army Reserve

EXPERIENCE

1951 - Present The Boeing Company

1951 - 1986 Boeing Commercial Airplane Company
1986 - Present Boeing Helicopter

SUMMARY OF BOEING EXPERIENCE

	FUNCTION	PROGRESSED TO	AIRCRAFT
1951 - 1960	Liaison	Jr. Engineer	(B-52, KC-97) KC-135, 707
1960 - 1965	Structural Design	Engineer	(727, C-5)
1965 - 1967	Preliminary Design	Lead Engineer	(727C, 737C) 747
1967 - 1973	Emergency Evacuation Systems	Project Manager	(747)
1973 - 1985	Payload Systems	Sr. Project Manager	(747, 757)
1985 - 1986	Advanced Composites	Chief Engineer	
1986 - Current	Engineering/ILS	Deputy Director (V-22)	

LICENSES

Professional Engineer - Washington

BOEING RECOGNITIONS

EXPO - Executive Potential Candidate 1967 - 1975

BEGNF - Board of Trustees (Boeing Employees Good Neighbor Fund) 1968 - 1969

Inventions:

Airplane Slide/Raft Survival Kit - 1983

Vehicle Overhead Stowage Bin Unit - 1985

Over 200 hours of Company Sponsored Management and Technical training

INTERESTS

Golf, skiing, fishing, charities, politics

C. CO-SPONSOR BACKGROUND AND GENERAL INFORMATION

The company was formed in 1943 and pioneered the development of large tandem rotor helicopters. In the 1950's the company supplied H-21 rotorcraft to the U.S. Army and HUP rotorcraft to the U.S. Navy. In the 1960's and 1970's the company supplied CH-47 rotorcraft to the U.S. Army and CH-46 rotorcraft to the U.S. Navy. In the 1980's programs were developed to remanufacture/update both fleets of the CH-47 Chinook and CH-46 Sea Knight rotorcraft to extend the useful lives of those products at significant cost savings to the U.S. Government. The Boeing Airplane Company acquired the company in 1961, and it is now called The Boeing Helicopter Company (BHC).

To enable development over the years of the products described above BHC has constantly initiated the technical expertise to bring state-of-the-art components into their large helicopter products. Towards that, then, BHC today has a facility which is expert in the design and manufacture of large airframe, large transmission/drive trains, rotor hubs, rotor blades, flight controls, avionics, landing gears, and power plants associated with large helicopter products. BHC continues to pioneer the use of advanced composites in the basic airframe structure and in the dynamic components (drive trains, hubs, blades). All the disciplines required to design and produce an air vehicle are within the facility (engineering, planning, tooling, manufacturing, procurement, testing, data management, overhaul, and product support).

BHC is currently midway in a major program to remanufacture several hundred CH47 helicopters for the U.S. Army. BHC is also in progress under contract for the design and development of a large tilt rotor aircraft for the U.S. Navy, with first delivery scheduled for 1991. That aircraft is also designed for the Air Force, Marines, and Army markets, with potential quantities of several hundred aircraft over the next several years.

D. APPENDICES

APPENDIX I

Bell Boeing
THE TILTROTOR TEAM

THIS IS THE AIRCRAFT THAT WILL BE BUILT WHOLELY OUT OF COMPOSITE MATERIALS AND THE FIRST IN A NEW BREED OF VEHICLE USING THIS TECHNOLOGY

V-22 OSPREY

Joint Services
Advanced Vertical Lift
Aircraft Program

U.S. MARINE CORPS

U.S. NAVY

U.S. AIR FORCE

U.S. ARMY

41

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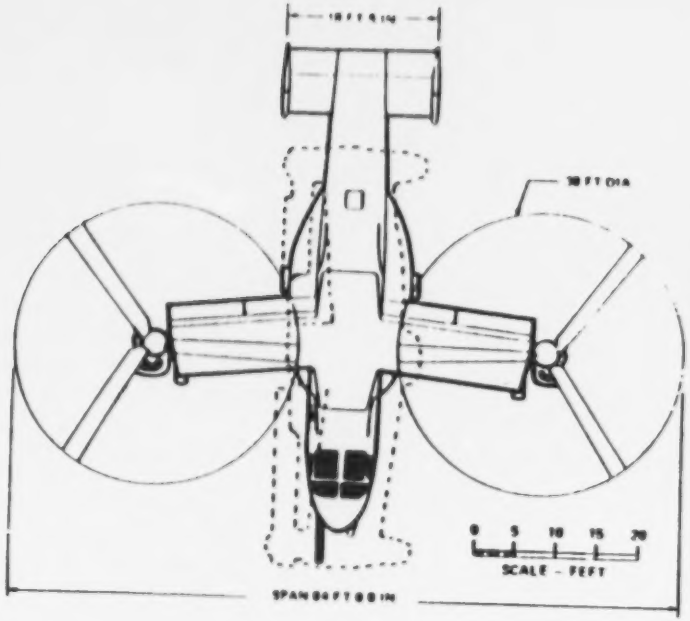
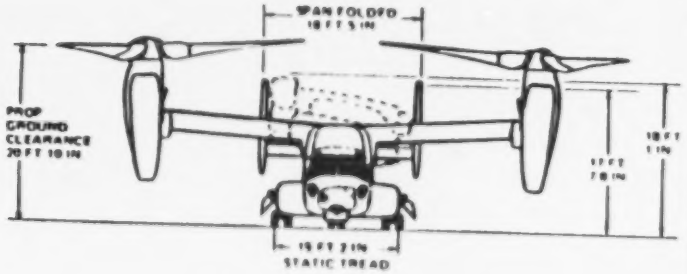
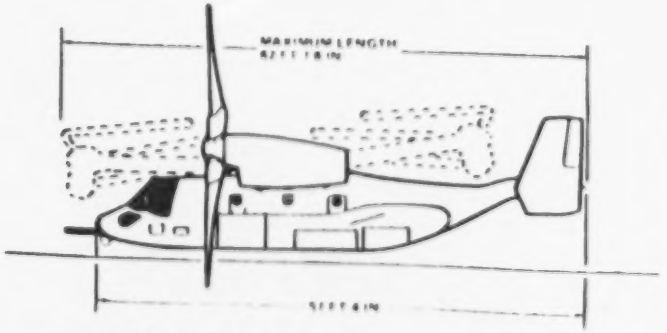






AIRCRAI DESCRIPTION

The V-22 is a tiltrotor aircraft. Its wing tip mounted engines and proprotor systems rotate, allowing it to take off and land vertically like a helicopter and once airborne fly like a modern turboprop aircraft. The 38 foot diameter proprotors are powered by two Allison T406 AD-400 engines. The proprotors fold and the wing stows parallel to the fuselage for compact shipboard stowage and maintenance.

MISSION REQUIREMENTS

USMC

Carry 24 troops 200 NMI radius at 3,000 ft 91.5°F
External load 10,000 pounds

USN

Rescue 4 people up to 460 NMI radius with a 3,000 ft 91.5°F midpoint hover (OGE)

USAF

Carry 12 troops 520 NMI radius with a midpoint hover (OGE) at 4,000 ft 95°F

US ARMY

Carry 24 troops or 12 medevac litters. Lifts 15,000 pounds using tandem external hooks.

POWER PLANT

No. & Model	2 T406-AD-400
Manufacturer	Allison Gas Turbine Division
Engine Spec No	937 (Fourth Draft) 22 July 85
Type	Turboshaft

RATINGS

	SHP	RPM	ALT
Maximum	6,150*	15,000	Sea level, 59°F
Intermediate	6,150*	15,000	Sea level, 59°F
Maximum Continuous	5,890	15,000	Sea level, 59°F
Transmission Limits	3,521**	12,575	Cruise rpm
	4,200**	15,000	USMC
	4,570**	15,578	USN, USAF
	5,920	15,578	OEI

*Engine Torque Limit 2,153 ft-lb
**RHP

WEIGHTS

Loading	Weight (lb)
Empty	31,772
Max Takeoff (VTO)	47,500
Max Takeoff (STO)	55,000
Self Deployment (STO)	60,500

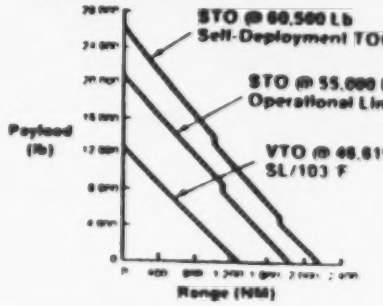
CHARACTERISTICS

Crew (mission)	1
Cabin Size	
Length	240 in
Width	71 in
Height	72 in
Usable Volume	858 ft³
Rescue Hatch Dimensions	40 in x 28 in
Provision for Troop Seats	24
Provision for Litters	12
Rescue Hoist Capacity	600 lb
Cargo Floor Limit	300 psf
Cargo Hook Capacity	10,000 lb single 15,000 lb dual
Max Cargo Weight	20,000 lb internal 15,000 lb external
Cruise Speed (S.L.)	275 knots
Dash Speed	300 knots
Self-Deployable	2,100 nmi
Shipboard Compatible	

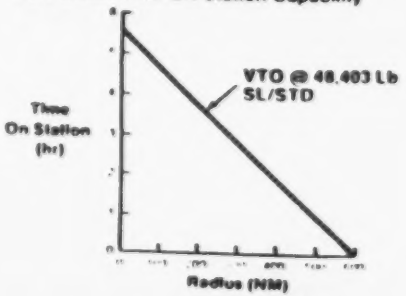
V-22 PERFORMANCE

RESERVE FUEL = MAX OF 30 MIN @ V_{BR} OR 10% INITIAL FUEL

USMC Payload-Range Capability



USN CSAR Time-On-Station Capability



COMPOSITE MATERIALS - INFORMATION SHEET

Composite Materials Technology is a highly sophisticated, state-of-the-art manufacturing and materials process. It involves the use of a combination of materials in specialized configurations or shapes that are bonded together with adhesive and heat to form a structural unit. There are a variety of materials used - metals, specialized fabrics, plastics, and fiberglass in the construction of composite structures. The primary advantages to industry in using composites is greater strength with significant weight reduction along with the ability to create complex shapes and figures in a single piece.

Working with composite materials, both in fabrication and in assembly requires specialized processes and techniques. Fabrication involves new blueprint technology (showing multiple layer requirements), specialized cutting and layup materials procedures, new molding techniques and specialized curing processes and non-destructive quality testing. Assembly of composites, because of their multiple material construction and design characteristics (hardness, different material sandwiching, and resins) requires specialized tools, procedures and fasteners to meet assembly specifications. Specifically, diamond tipped and carbide bits are necessary to drill, cut and ream in specialized composites (called graphite composites) that are being used by Boeing Vertol in their new helicopter design technology.

Additionally, because of the stringent industry requirements in aircraft manufacturing and the close tolerances required, there are additional specialization requirements to be incorporated. These requirements manifest themselves in specialized riveting and fastener systems which have special installation and removal tools, extremely close tolerances in drilling, countersinking and reaming requirements, and final surface requirements for air drag which necessitate shaving rivet and fastener heads off flush with the outer surface.

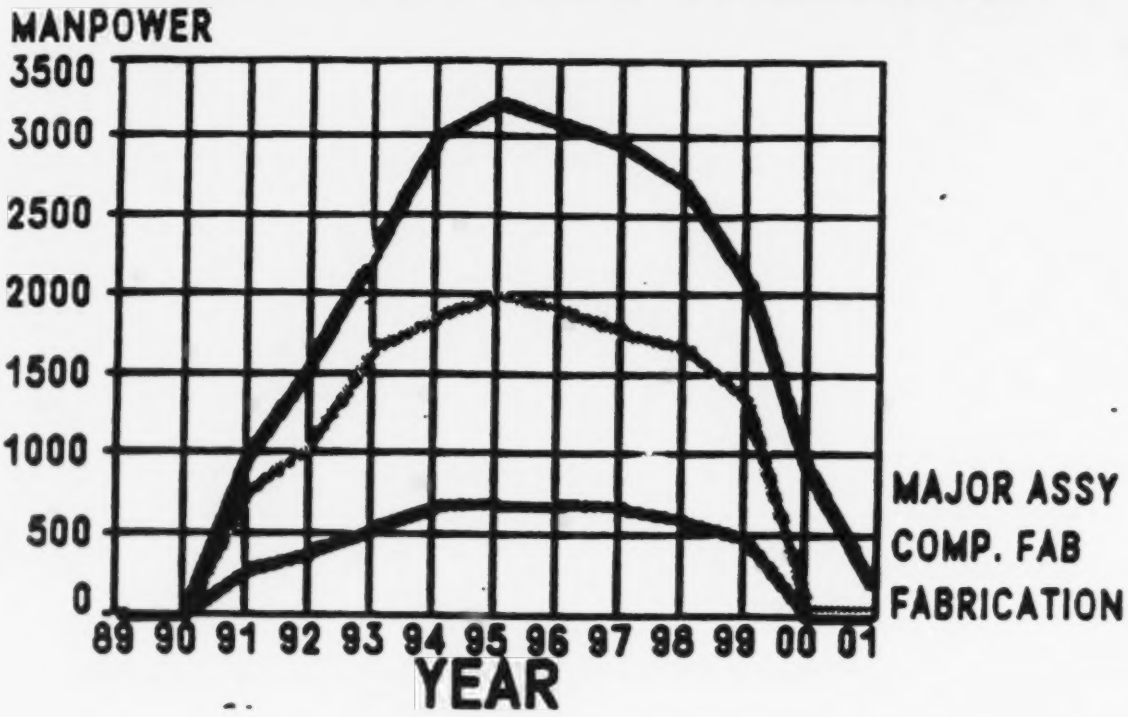
COMPOSITES INDUSTRY BACKGROUND

The materials used by the aerospace and related industries are rapidly changing from aluminum alloy to graphite composite. The manufacturing, shaping and construction with graphite composite material is so new that no training programs have the capability at this time to prepare the thousands of workers that will be needed by the industries that will utilize graphite composite material now and in the future. It can be predicted that the state which develops the capacity to prepare the needed work force will keep their existing companies and attract new companies which need knowledgeable, competent, productive workers who have mastered this technology.

Boeing Vertol is a large employer in Delaware County. Their need for employees who are competent in working with graphite composite material is documented in the attached booklet. At this time they are a leader in the use of this new technology. However, even with this leading edge, the cost of providing all the training necessary for their work force makes it hard to be competitive with other industrial giants in our nation and in the world market.

APPENDIX II

V-22 MANPOWER BUILD-UP
MANUFACTURING OPERATIONS



ESTIMATED TRAINING NEEDS BY TYPE

– MANUFACTURING SKILLS/COMPOSITES

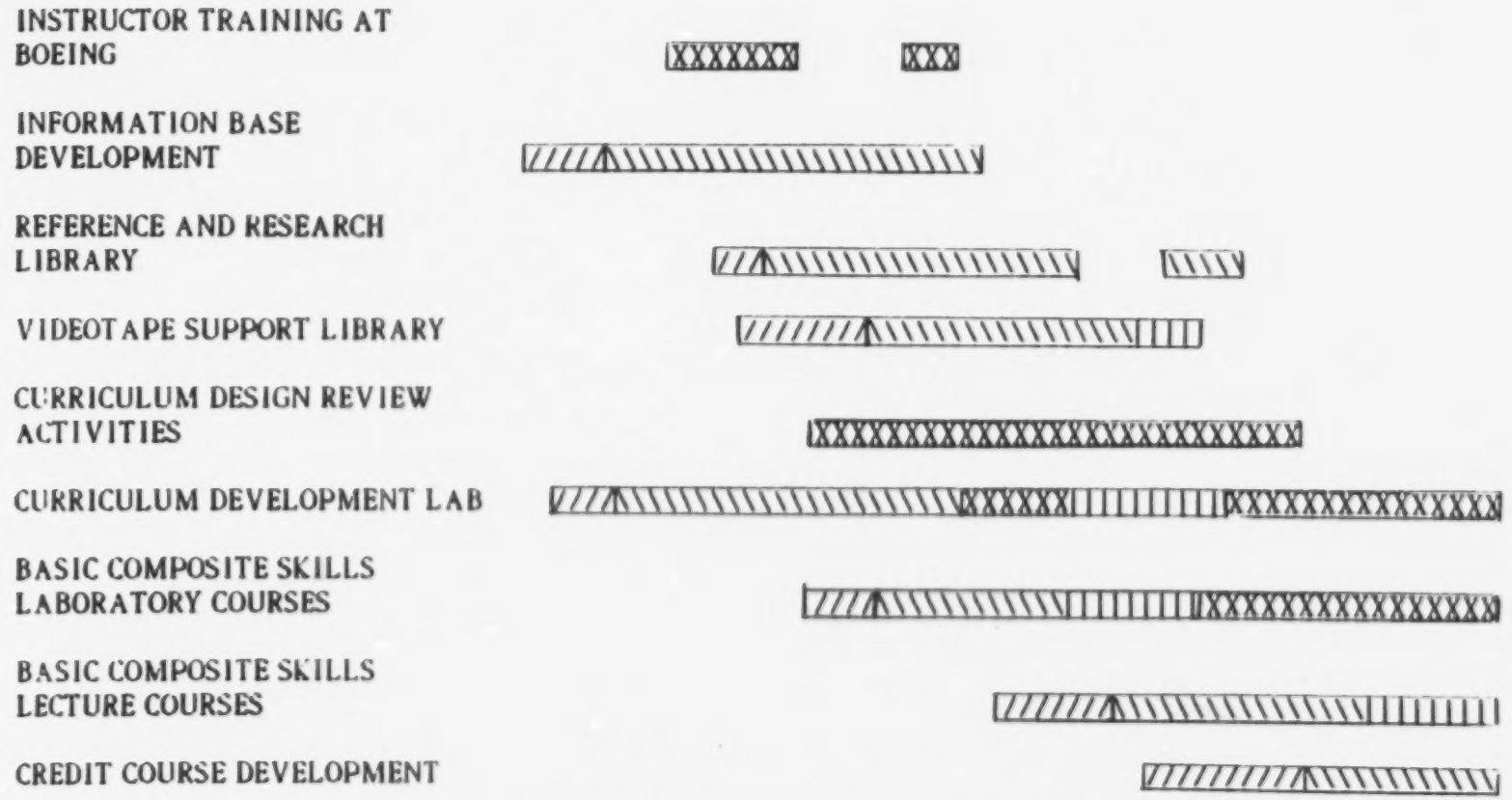
APPENDIX III

CHRONOLOGICAL SEQUENCE OF COMPOSITE MATERIALS PROGRAM

DATE	ITEM	WHO	BY
Apr.-Nov. 87	Conduct instructor search	PSU	Dr. Tomezsko
Jun. 87	Finalize Boeing in-plant instruction schedule	Boeing	G. Carlson
Jul. 1-3, 87	Conduct joint Boeing-PSU orientation and schedule/reporting procedures	PSU/ Boeing	D. McComb/ G. Carlson
Sept. 87	Complete plans and layout of composites curriculum development laboratory	PSU	D. McComb
Oct. 87	Prepare proposal and schedule for laboratory	PSU	D. McComb
Jan. 88	Begin PSU faculty residency at Boeing	PSU/ Boeing	E. McQuillen/ G. Carlson
Jan.-Jun. 88	Conduct assistant instructor search	PSU	Dr. Tomezsko
Mar. 88	Concept of a six-course basic composite skills training program formulated	PSU	E. McQuillen
Mar.-Apr. 88	Prepare grant proposals for detailed curriculum development and training equipment procurement	PSU	E. McQuillen/ M.K. Cote
Mar. 88	Begin establishment of reference/research library	PSU	E. McQuillen
Jun. 88	Establish campus curriculum review committee	PSU	Dr. Tomezsko
May 88	Complete PSU faculty residency at Boeing	PSU	E. McQuillen
Jul. 88	Finalize assistant instructor hiring for September start	PSU	Dr. Tomezsko
Sept. 88	Conduct orientation and begin asst. training, some at Boeing	PSU/ Boeing	E. McQuillen/ G. Carlson
Sept. 88	Initiate development of detailed curricula for six basic composites skills courses	PSU	E. McQuillen & Asst.
Dec. 88	Complete composites laboratory bldg. and initiate set-up of equipment and facilities	PSU	J. Slaugh E. McQuillen & Asst.

DATE	ITEM	WHO	BY
Jan. 89	Initiate design activities on credit courses to support associate degree and certificate programs	PSU	E. McQuillen
Feb. 89	Initiate development of supporting videotape library detailing process techniques, equipment operation, and techniques/processes only available at Boeing	PSU	Asst. Instructor
Mar. 89	Schedule field testing of courses with regional voc-ed instructors & Shenango Valley PSU faculty	PSU	M.K. Cote
Jun. 89	Conduct field training courses	PSU	E. McQuillen
Sept. 89	Begin offering non-credit basic composite skills courses	PSU	E. McQuillen
Sept. 90	Begin offering composite structures credit courses as options in established certificate and associate degree programs	PSU	E. McQuillen
Sept. 91	Begin offering composite structures credit courses as option in established baccalaureate degree programs	PSU	E. McQuillen
Sept. 92	Begin offering composite structures graduate credit courses through Great Valley Graduate Center	PSU	E. McQuillen

CHRONOLOGICAL SEQUENCE OF COMPOSITE MATERIALS TECHNOLOGY PROGRAM


INSTRUCTOR TRAINING AT BOEING
INFORMATION BASE DEVELOPMENT
REFERENCE AND RESEARCH LIBRARY
VIDEOTAPE SUPPORT LIBRARY
CURRICULUM DESIGN REVIEW ACTIVITIES
CURRICULUM DEVELOPMENT LAB
BASIC COMPOSITE SKILLS LABORATORY COURSES
BASIC COMPOSITE SKILLS LECTURE COURSES
CREDIT COURSE DEVELOPMENT
Planning
Development
Testing
Operational
I J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J
U U U
L L L
Y FY 1987-88 Y FY 1988-89 Y FY 1989-90